Statement of
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Introduction

Mr. Chairman, I am William D. Magwood, IV, Director of the Department of Energy's Office of Nuclear Energy, Science and Technology. I would like to thank the Subcommittee for the opportunity to discuss the nuclear energy research and development provisions contained in H.R. 1679, *Electricity Supply Assurance Act of 2001* and H.R. 2126, the *Department of Energy University Nuclear Science and Engineering Act*. The latter is the companion bill to S. 242, introduced by Representative Judy Biggert this week. I am pleased to appear today to discuss legislation that promotes the expanded use of nuclear energy in the United States and that seeks to strengthen the Nation's nuclear science and technology education infrastructure.

As a reliable, safe, and economic source of electricity for our Nation, nuclear energy is a key element of our energy portfolio, accounting for 20 percent of all electricity generation. Nuclear energy remains the largest source of emission-free electricity in the United States and for the first time in over a decade, it surpassed coal-fired plants as the leader in low-cost energy production. Today, we expect most, if not all, of the Nation's 103 existing nuclear power plants to extend their operating licenses another 20 years. As we face rapidly rising natural gas prices, concerns about refinery and pipeline capacities, and growing concerns about air pollution, the Nation's utilities are demonstrating a renewed interest in the nuclear option as a viable alternative for new generating capacity in the United States. Vice President Cheney said it best when speaking of the Administration's National Energy Policy before the Nuclear Energy Assembly on May 22, 2001:

> *"nuclear power is a very important part of our energy policy today in the United States,"*
> *"... continued advancements in the nuclear energy industry are vital to the nation's economic and environmental future."*

Nuclear energy is a key part of the Administration's strategy to increase domestic production, reduce dependence on imports of supply, manage environmental impacts of energy use, and protect our economy and our national security. Nuclear energy, as a highly reliable and affordable energy source, provides energy security today and is an important option for affordable, plentiful, and environmentally sustainable energy in the future.

The legislation introduced and under discussion today, represents the first major nuclear energy legislation since the passage of the Energy Policy Act of 1992. Although the primary focus of my testimony is on the research and development provisions and the nuclear educational initiatives of the legislation within the jurisdiction of this Subcommittee, I would like to express our general support for legislation such as this that sets a direction to implement our new National Energy Policy. We look forward to working with this Subcommittee as we set our priorities for the future.

H.R. 1679 promotes expanded use of nuclear energy as a major component of the Nation's energy strategy and establishes provisions to facilitate the production of more electricity from the Nation's nuclear power plants while encouraging planning for the construction of new advanced nuclear power plants. Also, the legislation addresses challenges to the overall nuclear fuel cycle, including provisions to ensure domestic supply of uranium, conversion, and enrichment as well as investigation of technologies that can reduce the toxicity and quantity of high level radioactive waste requiring geologic disposal.

H.R. 1679 also includes provisions that establish a supportive nuclear energy policy and regulatory framework, supporting NRC's efforts to transition to risk-informed regulations and fund research supporting regulation of new reactor designs. In addition, the bill addresses the renewal of the Price-Anderson Act and clarification that the funds set aside for eventual decontamination and decommissioning (D&D) of nuclear plants will not be taxed with the purchase of nuclear units.

In particular, Price-Anderson renewal and the D&D fund tax provisions are legislative actions that were recommended in the National Energy Policy and are important to enabling the extended operations of the Nation's existing nuclear plants and to the deployment of plants in the future. Both Secretary Abraham and the DOE's Deputy General Counsel have testified before the 107th Congress in support of renewal of Price-Anderson Act and have offered detailed comments on this bill as well as similar provisions in other bills that are under legislative consideration.

Finally, the Administration supports the objectives of H.R. 2126. Over the last decade, the Nation's nuclear science and technology education infrastructure has declined in the United States, with universities ending their nuclear engineering programs and closing critical research facilities. Implicit in the National Energy Policy is the need for a qualified and trained nuclear science and engineering workforce. We strongly believe that our ability to respond to the energy supply, environmental and medical challenges over the next several decades will hinge on the investments we make today both in terms of research and development and in terms of efforts to sustain and enhance the critical educational infrastructure needed to prepare the next generation of scientists and engineers.

Retrospective on Federal Nuclear R&D

Beginning in the 1940's and extending through the 1980's, the United States led the world in the first generation of commercial nuclear energy. The Government initiated development of nuclear energy technology, constructed and operated prototype nuclear power plants, shared the initial deployment risk with industry, and developed a policy framework that allowed industry to commercialize this technology. Through President Eisenhower's *Atoms for Peace* initiative, the United States shared this technology with other countries in exchange for the commitment not to develop nuclear weapons. This has been a success story for the country, with 20 percent of our electricity coming from 103 highly efficient nuclear plants and with all but four countries having signed the Nuclear Non-Proliferation Treaty.

In the early 1990's, the Department of Energy cooperated with industry to develop advanced light water reactors to meet energy needs early in the 21st Century. This resulted in the certification of three advanced light water reactor designs which are available to the domestic and international markets today.

Recognizing that reactors of this type extract only about 1 percent of the energy content of uranium, the United States was also developing sodium-cooled "fast" spectrum reactors that use uranium far more efficiently and could provide a long-term sustainable nuclear energy resource. The United States was also developing fuel recycling technologies that could reduce the nuclear waste burden and the threat of proliferation.

However, by 1998, all of these nuclear energy research and development programs had been terminated and policies were enacted that discouraged the use of nuclear energy or placed it at a competitive disadvantage. As you know, the Vice President's policy group has recommended that the Nation reexamine those policies within the context of advanced generation reactor and fuel cycle technologies, to allow the research, development and deployment of technologies that reduce waste streams and enhance proliferation resistance. In essence, the recommendations to the President are to examine technologies for optimizing or closing the overall nuclear fuel cycle. These recommendations are very much in agreement with the urgings of much of the nuclear technology community and our international research partners.

Over the last several years, with the tightening of electricity supply, the future of nuclear is brighter than at any time over the last three decades. There is broader public acceptance of nuclear energy as an important energy source to our Nation's electricity supply. For the last several years, existing nuclear plants have operated at peak performance, setting availability and performance and safety records.

If we are to see sustainable nuclear energy systems in the long-term, both industry and Government must take action. Industry must bear the responsibility for deployment and operation of nuclear technologies. Government should promote a supportive policy and regulatory framework for nuclear energy, adopting policies that encourage greater output from existing plants and that remove barriers to expanded use of nuclear power, including providing efficient and effective regulation, and conducting higher risk research that is beyond the planning horizon of industry. Where possible, government should maximize Federal investment through cost-sharing approaches with industry, greater collaboration, and through cooperation with our international partners.

Over the last three years, my office has reformed its nuclear energy R&D portfolio. With Congress' help, we successfully launched the Nuclear Energy Research Initiative, the Nuclear Energy Plant Optimization program, and initiatives to explore Generation IV advanced reactor and fuel cycle technologies.

We are working with industry to develop advanced technologies that are beyond the scope of R&D funded by industry alone to enhance the reliability, efficiency and safety of current plants as they operate for the long term. We are working with industry and the Nuclear Regulatory

Commission to resolve technical and regulatory issues in order to enable new plants to be built in the United States before the end of the decade. We are also funding advanced research to address the very long-term issues associated with expanded use of nuclear energy.

Through our Generation IV initiative, we are developing a technology roadmap to evaluate a variety of advanced nuclear energy system concepts and to define the needed research activities for the most promising concepts. This roadmap, which is highlighted in H.R. 1679, has become a large international project involving over 100 experts from 10 countries working on many technical working groups. We have established an international collective, the Generation IV International Forum, or GIF, through which the United States and other nuclear-experienced nations will be able to work together to set the goals, establish the programs, and collaborate in the research that will lead to next-generation nuclear energy systems. The activities of the GIF are proceeding and I expect we will soon sign a Generation IV charter with the international community, providing the framework for international cooperation in research and development for the next generation of nuclear energy systems.

My office also conducts a wide range of other advanced nuclear technology activities that are not related to energy generation. For example, under our Advanced Nuclear Medicine Initiative, we are conducting exciting new research to find treatments for cancer using medical isotopes and supplying a wide range of isotopes to researchers in the United States. NE conducts the research and builds the energy systems that power NASA's space missions that go beyond Earth's orbit.

Finally, we are responsible for the Department's nuclear technology infrastructure, which like the university educational infrastructure addressed in H.R. 2126, is critically important to research needed to support the expanded use of nuclear energy. Federal investments in these technologies will be critical in order for the American people to continue to realize the benefits of these technologies.

The remainder of my testimony provides a brief summary of our research initiatives, our nuclear science and technology educational initiatives within the context of this legislation considered today, including the current status of the programs and their current funding levels in relation to proposed future investments.

Nuclear Energy Research Initiative

The Nation will need nearly 400,000 megawatts of new electrical generating capacity to meet projected demand over the next 20 years and to offset power plant closings, according to the Energy Information Agency. This capacity is equivalent to building about 40 new mid-size power plants every year for the next 20 years. Americans have come to expect access to energy that is affordable, plentiful, and environmentally sustainable. Clearly, in order to meet a national mandate of this magnitude, nuclear energy must be a part of a balanced supply portfolio.

In 1999, the Department launched the Nuclear Energy Research Initiative (NERI), as a competitive, peer-reviewed research and development program to fund researcher-initiated R&D technology. The goals of NERI are to develop revolutionary advanced concepts and scientific breakthroughs in nuclear fission and reactor technology to address scientific and technical barriers to the long-term use of nuclear energy; advance the state of nuclear technology to maintain a competitive position in overseas and future domestic markets; and promote and maintain the nuclear science and engineering infrastructure to meet future technical challenges. The program is managed to promote collaboration among United States research institutions and information exchange with international organizations. Despite its limited funding, it has gone a long way to reinvigorate nuclear R&D in this country and signal the return of the United States to nuclear R&D.

Just this month, DOE announced the award of 13 new NERI projects to researchers from eight universities, eight national laboratories, eight private sector organizations, and collaborators from six overseas research organizations. There are 54 other projects initiated in prior years currently underway; two NERI projects have been successfully completed -- one, on modular construction techniques for nuclear plants and the other on, development of temperature-resistant fuel cladding.

This fiscal year, the Department launched an international version of NERI, the International Nuclear Energy Research Initiative (I-NERI), for innovative scientific and engineering research and development by joint teams of United States and foreign researchers. Established as a cost-shared R&D program, the objectives of the I-NERI program are to promote bilateral and multilateral collaboration with international agencies and research organizations; improve the development of nuclear energy; and promote and maintain the United States nuclear science and engineering infrastructure to meet future technical challenges. We just signed an agreement with South Korea and expect to complete one with France this month. We also expect to conclude agreements with Japan and South Africa by the end of the year, and we are working on agreements with the Nuclear Energy Agency of the Organization for Economic Cooperation and Development and with Euratom.

Nuclear Energy Plant Optimization

For the last several years, with the demand for electricity at record highs, nuclear plants have generated record amounts of electricity -- safely and reliably. The nuclear share of electricity generation in 2000 (almost 23 percent of the total) also set a record. Over the last two years, the amount of additional generation alone is about equal to what would have been needed to meet all of the residential needs of California. One of the most effective ways to increase electricity generating capacity is to obtain more energy from existing nuclear plants.

To support improved, longer-term reliable and safe operations of these plants, in Fiscal Year 2000, the Department proposed and Congress funded the Nuclear Energy Plant Optimization (NEPO) Program. The primary areas of focus of the NEPO program are on plant aging issues and on approaches to optimize electrical production. The NEPO Program represents a public-private R&D partnership with equal or greater matching funds coming from industry and is conducted in close cooperation with the Nuclear Regulatory Commission. The research conducted under this program is identified, prioritized, and selected with broad input from utilities, national laboratories, NERAC, and other stakeholders.

University Programs

Government, industry, and academia face similar challenges today as we seek to preserve the aging but highly developed science and technology infrastructure that the United States has developed over the last 50 years. Preserving the human and research facility infrastructure at our universities and colleges remains key to preparing tomorrow's nuclear scientists and engineers. More trained personnel will be required to ensure an adequate knowledge base for innovation and technological advancement.

For several years, DOE and Congress have provided support to nuclear engineering, science and technology programs at United States universities. This program, funded at about $12 million annually, supports the operation and upgrade of university research reactors, provides fellowships and scholarships to outstanding students, provides matching grants, and sponsors Nuclear Engineering Education Research (NEER) grants. Collectively, these initiatives help maintain domestic capabilities to conduct research and the infrastructure necessary to attract, educate and train the next generation of scientists and engineers with expertise in nuclear energy technologies.

The NEER initiative stimulates innovative research at United States universities, with an infusion of about $5 million annually. This investigator-initiated, peer reviewed research program is vital to attracting and retaining faculty and students in nuclear engineering programs. This year, with well over 100 proposals received from universities, the Department awarded 19 new NEER grants to 14 universities that, with continuation of existing grants, increases the total research projects underway to 50.

Through my office's Advanced Accelerator Applications (AAA) program, the Department sponsors research, internships at national laboratories, and a fellowship initiative for graduate students who are interested in the highly specialized area of transmutation of waste. About 65 students are or have been involved in these initiatives, with 10 new fellowships just recently awarded. Under our Advanced Nuclear Medicine Initiative, we also sponsor curriculum development in medical isotope technologies. In the future, we hope to sponsor graduate and post-doctoral candidates who are developing nuclear medicine therapies to treat serious illnesses.

University research reactors in the United States form a vital component of the nuclear science and technology and education infrastructure in this country. These facilities are an important source of neutrons supporting research that is critical to national priorities such as health care, materials science, environmental protection, food irradiation, and energy technology. Currently, there are 29 operating research reactors at 27 campuses in 20 states. The Department presently provides about $3.7 million annually for fuel for university reactors and for upgrades to reactor instrumentation and equipment.

In contrast to the growing national need for trained and qualified graduates in nuclear engineering, the last several years has seen a decline in university nuclear engineering programs. Fueled by out-dated impressions about the state and likely future of nuclear energy in this country, some universities have closed their nuclear engineering programs and research reactors. Others facing financial pressures are also considering the closure of their research reactors. These research reactors, such as the facilities at MIT and the University of Michigan, are a vital part of the Nation's nuclear science and technology and education infrastructure, supporting research critical to health care, materials science, environmental protection, food irradiation, and energy technology. Another important facility, the Ward Center research reactor at Cornell, was closed even *after* the President announced the Administration's National Energy Policy. We are very concerned about these developments and the impact that closure could have on the research infrastructure in the United States as well as on our ability to prepare the next generation of nuclear scientists and engineers.

Last year, NERAC formed a special task force chaired by Bob Long, former Senior Vice President of GPU Nuclear and former professor at the University of New Mexico. On April 30, 2001, the task force issued their report, recommending that the Department set up a longer-term structure to assure the continued operation of a limited number of nationally significant research reactors.

With respect to the long term future, the task force recommended that the Department put a process in place to establish regional university research reactor user facilities. We will be convening a workshop in a few weeks to explore how best to develop the concept of regional user centers.

The need for Federal government support for the nuclear engineering, science and technology education infrastructure in the United States has been well documented over the last decade. The recent NERAC task force, a prior Blue Ribbon Panel of the NERAC, the Nuclear Engineering Department Heads Organization (NEDO), and the National Organization of Test, Research and Training Reactors (TRTR) have all concluded that it is vital for the government to act now to address the decline of the Nation's nuclear engineering programs, including their vital research facilities. There is broad support in the nuclear industry and within the nuclear university community for H.R. 2126 and its Senate counterpart, S. 242.

Development of a National Spent Fuel Strategy

The Administration supports provisions of H.R. 1679 that call for the development of a national spent fuel strategy, a strategy that investigates the use of advanced technologies to close the nuclear fuel cycle by 2050 so that the quantity and toxicity of future spent fuel wastes can be reduced by as much as 90 percent. Not only would this improve the ability of a geologic repository to store nuclear waste, but it would enable the world's nuclear fuel supply to last about 1,000 years.

H.R. 1679 calls for research and development to further the availability of electrometallurgical technology as a proliferation resistant alternative to aqueous reprocessing and research into the use of high energy accelerators to reduce toxicity of nuclear waste. As you know, the Vice President's policy group has recommended examining electrometallurgical technology as well as other potential fuel recycle technologies as a means of closing the nuclear fuel cycle.

The Department has considerable experience with electrometallurgical treatment technology and is currently using this technology to treat spent fuel from the Experimental Breeder Reactor II at Idaho to remove hazardous constituents to enable eventual geologic disposal. The Department believes that this, and other advanced reprocessing technologies, should be evaluated for the longer term as a means of reducing the toxicity of the waste and for recycling of fuel through a reactor. While aqueous processes are used extensively today throughout the world, advanced reprocessing technologies have the potential to handle a wide range of fuel forms, can be more proliferation resistant, can be more environmentally friendly and could be lower cost.

As you know, Department has been investigating the use of high energy accelerators for application to the back end of the nuclear fuel cycle to significantly reduce the radioactive toxicity and quantity of civilian spent nuclear fuel. We have made significant progress this past year refining the technical approach to transmutation of waste and are now analyzing a “dual tier” approach for transmutation of spent nuclear fuel that would further optimize the potential waste management gains from recycling.

Under this approach, 95 percent of the nuclear material separated from the spent fuel would be uranium useable in fabricating new fuel or would be disposed of as Class C Low Level Waste. The other five percent would be separated into two parts: plutonium, iodine and technetium and the other long-lived, highly radio-toxic actinides, leaving short lived fission products for geologic disposal. In the first tier, plutonium, along with iodine and technetium, would be transmuted in either existing light water reactors or new advanced reactors and would generate electricity that could potentially offset life cycle costs of the program. In the second tier, the other long-lived radio-toxic actinides could be transmuted in an accelerator driven sub-critical reactor system.

A benefit of this approach could be the more efficient use of the current geologic repository being studied by the Department, even with significant new nuclear plant generating capacity brought online in the future. This approach is favored by many of the countries with which we hope to partner in the future, particularly France.

Conclusions

Nuclear plants can be built small or large, they can be placed near cities or in remote locations. Nuclear power today generates electricity safely and cleanly and I would assert that it is among the greenest of our generating technologies. With proper attention to the nuclear fuel cycle, nuclear power can be made a near inexhaustible source of energy, having minimal environmental impact and only small compact volumes of solid waste that can be easily stored and monitored.

We are at a important point in our history, where the investments that are made today can have a significant impact on the Nation’s future access to reliable, plentiful and affordable electricity in the future. I appreciate the support for nuclear energy expressed by this legislation and look forward to working with this Subcommittee as we set our research and development priorities for the future.